Available online at www.sciencedirect.com

SCIENCE DIRECT®

Forest Policy and Economics xx (2006) xxx–xxx

Forest Policy and Economics

www.elsevier.com/locate/forpol

Government regulation of forestry practices on private forest land in the United States: An assessment of state government responsibilities and program performance

Paul V. Ellefson [a,*], Michael A. Kilgore [a], James E. Granskog [b]

[a] *Department of Forest Resources, University of Minnesota, St. Paul, MN, USA*
[b] *Southern Research Station, Forest Service U.S. Department of Agriculture, New Orleans, LA, USA*

Received 20 October 2005; received in revised form 25 March 2006; accepted 9 May 2006

Abstract

In 2003, a comprehensive assessment of state government, forest practice regulatory programs in the United States was undertaken. Involved was an extensive review of the literature and information gathering from program administrators in all 50 states. The assessment determined that regulatory programs focus on a wide range of forestry practices applied to private forests; state agencies regulating forestry practices are numerous and responsible for substantial investment in forest practice regulatory programs; 15 state governments have especially prominent regulatory programs; and past evaluations of regulatory program performance have produced mixed results. Program administrators suggest regulatory program design and administration would benefit from research focused on identifying forestry sectors requiring regulatory attention; design of regulatory programs and means for evaluating their performance; equity and distributional consequences of regulatory program enforcement; and the design of information management systems for monitoring regulatory programs.

Keywords: Forestry practices; Government regulation; Private forest land

1. Introduction

The design and administration of government regulatory programs have become of increasing interest in recent years. In the late 1990s, for example, the Organization for Economic Co-operation and Development undertook an extensive worldwide review of regulatory programs, concluding that an effective regulatory system requires a clear and consistent legal basis for regulatory policy, explicit and measurable standards for determining regulatory effectiveness, and ample capacity to administer and manage regulatory programs (Organization for Economic Co-operation and Development, 1997, 1999).

* Corresponding author. Tel.: +1 612 624 3735.
E-mail address: pellefso@umn.edu (P.V. Ellefson).

1389-9341/$ - see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.forpol.2006.05.001

States responded to the questionnaire's request for information.

3. Practices subject to regulatory programs

3.1. Application of practices

The assessment of regulatory activities focused on seven major categories of forest practices, namely:

- *Road and trail practices* (for example, water crossings, erosion control, material disposal sites, blasting standards, winter use and closures)
- *Timber harvesting practices* (for example, landings; skid trails; slash management; equipment; felling, bucking and yarding; residual stand damage; safety)
- *Reforestation practices* (for example, site preparation, timing, species selection, artificial or natural, regeneration levels, supplemental planting)
- *Cultural practices* (for example, early release treatments, thinning, pruning, stand improvement cuttings, stand health)
- *Chemical application practices* (for example, methods of application, intensity, timing, mixing, spill management)
- *Forest protection practices* (for example, fuel loads; fire prevention; disease and insect prevention; animal damage prevention, salvage and sanitation cuttings)
- *Administrative practices* (for example, planning, notifying, reporting, monitoring, evaluating, enforcing).

Program administrators in all 50 states considered all of the above practices to be applied to private forests. However, in very few instances were all categories of forestry practices viewed as always being correctly applied (all practices were always correctly applied in 9% of states) (Table 1). An average 59% of states considered all of the practices to be often applied in a correct fashion, while all practices were only sometimes being so applied to private forests in about one-third (31%) of the states. As for individual categories of practices, timber harvesting, roads and trails, and chemical application practices tended toward more correct application (always or often in 82%, 80% and 78% of states, respectively) while cultural, protection and administrative practices were more inclined to be sometimes or never correctly applied (cultural practices 50% of states, forest protection 46%, administrative practices 44%).

Table 1
Extent to which forestry practices are correctly applied on private forest land in the United States, by major forestry practice category, 2003

Major category of forestry practices	Degree to which forestry practices are judged to be correctly applied on private forests (percent of states)			
	Always	Often	Sometimes	Never
Road and trail practices	10	70	20	0
Timber harvesting practices	12	70	18	0
Reforestation practices	10	66	22	2
Cultural practices	2	48	50	0
Chemical application practices	18	60	22	0
Forest protection practices	6	48	46	0
Administrative practices	8	48	42	2
All major categories	9	59	31	1

3.2. Regulation of practices

Nearly two-thirds (32 states or 64%) of the program administrators reported that forestry practices applied to private forests are subject to some type of regulation, even if only under certain special conditions (Table 2). The most commonly regulated category of forestry practices was roads and trails (44 states) followed by practices involving chemicals (40 states), while least common was regulation of cultural practices (30 states) and reforestation activities (27 states). As for categories of forestry practices where all practices are regulated, such ranged from one state that regulated all cultural and all forest protection practices to 17 states (34%) that regulated all practices involving the application of chemicals. Some states take regulatory action only when a forestry practice is applied in such a way that certain standards (thresholds) are exceeded or certain conditions are not met. For example, inappropriate harvesting methods within a streamside management zone, refusal to apply appropriate water quality best management practices, or encountering habitats of

Table 2
Extent to which forestry practices applied on private forest land in the United States are regulated by state government agencies, by major forestry practice category, 2003

Major category of forestry practices	Degree to which forestry practices applied to private forests are judged to be regulated (percent of states)			
	All practices regulated	Some practices regulated	Only if certain conditions exist	No practices regulated
Road and trail practices	22	40	26	12
Timber harvesting practices	20	20	30	30
Reforestation practices	14	14	18	54
Cultural practices	2	20	18	60
Chemical application practices	34	38	8	20
Forest protection practices	2	42	16	40
Administrative practices	12	42	12	34
All major categories	15	31	18	36

Certain conditions (thresholds) calling for imposition of regulations could include sedimentary pollutants exceeding a water quality standard or tree planting occurring below acceptable levels of reforestation.

rare or endangered species of wildlife. Regulatory actions of such a nature occur in 13 states when road and trail practices violate a specified standard and in 15 states when timber harvesting results in surpassing or not meeting certain thresholds.

4. Agencies responsible for regulatory programs

4.1. Number of agencies

The number and breadth of state agencies responsibility for the regulation of forestry practices is extensive. Averaging 5.5 agencies per state, 276 agencies were identified as responsible for regulatory initiatives addressing a broad range of forestry concerns, including illegal placement of hazard waste in forested areas, inadequate reforestation of harvested areas, improper construction and maintenance of forest roads, and improper safety conditions for persons working in forested areas (Table 3). The most frequent focus of state government regulatory agencies involved forestry practices that had potential to adversely affect the quality of air and water resources, namely, 29% (81 agencies) of the 276 agencies identified. The diversity of regulatory functions implemented by state agencies is highlighted by the number of agencies in the "other agencies" category (above), namely, 55 agencies or 20% of the total. The regulatory focus of these agencies includes reclamation and restoration forested areas, law and rule enforcement, taxation and revenue collection, professional licensing and certification, human health and safety, forest trails and roads, archeology and historic preservation, forested coastal zone management, and regulation of solid and hazardous materials in forested areas.

Table 3
State agency involvement in regulation of forestry practices on private forest land in the United States, by agency function and region 2003

Agency primary function	Agencies engaged in regulation		Agencies per state engaged in regulation
	Number	Percent	
Air and water management and pollution control agencies	81	29	1.6
Forest resource management agencies	57	21	1.1
Fish and wildlife management agencies	30	11	0.6
Soil and resource conservation agencies	21	7	0.4
Insect, disease and invasive species agencies	8	3	0.2
Land use planning and management agencies	11	4	0.2
Parks and natural area management agencies	10	4	0.2
Economic development and transportation agencies	3	1	0.1
Other agencies	55	20	1.1
Total	276	100	5.5

Agencies per state rounded to tenth of an agency.

4.2. Intensity and type of involvement

State agencies involved in the regulation of forestry practices are not always uniform in the intensity of their regulatory activities. For purposes of this assessment, the extent of agency involvement in regulatory actions was categorized as extensive involvement (for example, a staff of eight or more full-time equivalents, and complex approval processes resulting in the issuance of permits or licenses usually issued prior to commencing the application of desired forestry practices); moderate involvement (for example, a staff of three to seven full-time equivalents, requirements that harvesters and landowners inform an agency of intent to voluntarily apply desired forestry practices); and minimal involvement (for example, fewer than three full-time equivalents, and agency policy requiring the application of certain forest practice standards [generous reforestation, appropriate slash disposal, limit environmental degradation] which are unlikely to be enforced).

Applying the above categories to the 276 state agencies previously identified, 149 agencies (54%) were judged to be either extensively (18%) or moderately (36%) engaged in forest practice regulatory activities (Table 4). Forty-six percent (127) of the agencies were regarded as having only minimal regulatory involvement. Examples of the latter group are agencies whose primary function involves land use planning, soil and conservation, insect and disease protection, and parks and natural area designation. In absolute numbers, extensive involvement was greatest for forest resource management agencies, namely, 49% of 57 agencies (30 agencies). A distant second and third were air and water pollution management agencies (10 of 81 agencies had extensive agency involvement) and fish and wildlife management agencies (six of 30 agencies).

State governments typically assign lead responsibility for forests and forestry to the state's forestry agency (for example, North Carolina Division of Forest Resources, Oregon Department of Forestry, Pennsylvania Bureau of Forestry). According to program administrators, the lead agency of 37 of these states engages in some form of forest practices regulation. Of these 37, the regulatory activities of 15 lead agencies are considered extensive, while in 13 states and in nine states a lead agency's regulatory involvement is judged to be moderate or minimal, respectively.

5. Administration of regulatory programs

5.1. Program coordination

State-initiated forest practices regulatory programs are not implemented without implications for other levels of government (for example, local, regional, federal) or for other units within state government (for

Table 4
State agency involvement in the regulation of forestry practices on private forest land in the United States, by agency primary function, extent of agency involvement, and magnitude of staff involved with regulatory programs, 2003

Agency primary function	Extent of agency involvement in regulation of forestry practices (percent of agencies)		
	Extensive	Moderate	Minimal
Air and water management and pollution control agencies	12	44	44
Forest resource management agencies	49	37	14
Fish and wildlife management agencies	20	43	37
Soil and resource conservation agencies	10	14	76
Land use planning and management agencies	0	9	90
Parks and natural area management agencies	0	50	50
Insect, disease and invasive species agencies	12	12	76
Economic development and transportation agencies	0	0	100
Other agencies	7	35	58
Total	18	36	46

Other agency primary functions include reclamation and restoration, law and rule enforcement, taxation and revenue collection, professional licensing and certification, human health and safety, trails and roads, archeology and historic preservation, coastal zone management, solid and hazardous materials, agriculture and food provisions, and environmental quality generally.

example, a state a pollution control agency, state department of agriculture). For purposes of harmonizing the implementation of regulatory responsibilities, almost all state laws and rules regulating forest practices require some degree of coordinating efforts (for example, memorandums of agreement, joint budgetary commitments, formal mechanisms such as boards and commissions). An example is Oregon where the state's forest practices act directs the State Board of Forestry to (prior to adopting rules) "...consult with other agencies of this state or any of its political subdivisions that have functions with respect to the purposes [of the act] or programs affected by forest operations. Board shall consider and accommodate the rules and programs of other agencies to the extent deemed to be appropriate and consistent with the purposes of the Act..." (OR Rev. Stat. Title 44 Chap. 527. Sec. 710). In a similar fashion, the Alaska Forest Resources and Practices Act calls for coordination, namely, the administering agency "...shall coordinate with other agencies and affected coastal districts that have jurisdiction over activities subject to regulation under this [Act]" (AK Stat. Title 41. Sec. 41.17.098).

Coordination can be viewed as occurring generally among state agencies that have regulatory responsibility for forest practices, but may also be viewed as state agencies coordinating with a state's lead forestry agency. Regarding the former, in 2000 the frequency of coordinating activities among all forest practices regulating entities was as follows: regularly coordinate–42% of entities; seldom coordinate–50%; and never coordinate–8% (Ellefson et al., 2003). As for regulatory agencies coordinating their programs with a state's lead forestry agency, such occurs—but it is modest (Table 5). Of the 276 regulating agencies previously identified, administrators indicated that only 38% (105 agencies) engaged in extensive coordination on regulatory matters, while slightly less (32%, 88 agencies) have no or minimal coordinating involvement with a state's lead forestry agency. Fish and wildlife management agencies, air and water pollution preventing agencies, and agencies engaged forest health and protection are more inclined to coordinate with a lead forestry agency, while soil conservation agencies, land use planning agencies, and parks and natural area agencies are less inclined to do so.

5.2. Program investments

Implementation of regulatory programs can require significant agency investment in a variety of tasks, including rule-making, issuance of permits, on-site inspections, enforcement actions, and addressing legal challenges made by the regulated public. State forestry program administrators estimated that in 2003 the 276 agencies regulating forestry practices applied on private forests required the services of 1047 full-time equivalent (FTE) staff (Table 6). Fifty-seven percent of these agencies engaged three or fewer FTE regulatory program staff, 20% had three to seven FTE staff, and 23% employed seven or more FTE staff.

Nearly one-third (a total of 323 FTEs) of the staff employed by regulating agencies are part of an agency

Table 5
State agency involvement in the regulation of forestry practices on private forest land, by agency primary function and degree of coordination with lead state forestry agency, 2003

Agency primary function	Portion of regulating agencies coordinating with state's lead forestry agency on regulatory activities (percent of agencies)			
	Extensive	Moderate	Minimal	None
Air and water management and pollution control agencies	26	38	34	2
Forest resource management agencies	88	10	2	0
Fish and wildlife management agencies	40	37	20	3
Soil and resource conservation agencies	29	24	33	14
Land use planning and management agencies	0	45	55	0
Parks and natural area management agencies	10	20	60	10
Insect, disease and invasive species agencies	38	24	38	0
Economic development and transportation agencies	0	100	0	0
Other agencies	20	34	33	13
Total	38	30	27	5

Table 6
State agency involvement in the regulation of forestry practices on private forest land in the United States, by agency primary function, number of agencies, and size and distribution of staff, 2003

Agency primary function	Number of agencies engaged in regulation	Distribution of full-time equivalent staff involved in regulation of forestry practices (percent of agencies)			Total full-time equivalent staff involved in regulation of forestry practices		
		<3 FTEs	3 to 7 FTEs	>7 FTEs	Total FTEs.	Percent	FTEs per agency
Air and water management and pollution control agencies	81	67	15	18	266	25	3.3
Forest resource management agencies	57	28	21	51	323	31	5.7
Fish and wildlife management agencies	30	50	17	33	131	13	4.4
Soil and resource conservation agencies	21	67	19	14	68	6	3.2
Land use planning and management agencies	11	91	9	0	22	2	2.0
Parks and natural area management agencies	10	50	30	20	41	4	4.1
Insect, disease and invasive species agencies	8	76	12	12	22	2	2.8
Economic development and transportation agencies	3	100	0	0	5	1	1.7
Other agencies	55	65	29	6	169	16	3.1
Total	276	57	20	23	1047	100	3.8

FTE is full-time equivalent staff. Total FTEs based on interpretation of FTE categories as follows: <3 FTEs=1.5 FTEs, 3–7 FTEs=5.5 FTEs, and >7 FTEs=8.0 FTEs.

whose primary function is forest resource management, while slightly more than one-quarter of the FTE staff are affiliated with air and water pollution control agencies. The size of any single regulatory agency's staff ranges from less than one FTE (economic development and transportation agencies) to nearly six (5.7 FTEs) for forest resource management agencies. Excluding the "other agencies" category, 72% of the agencies have 3.2 or more FTE staff assigned to programs that regulate forestry practices. Assuming a full-time equivalent requires an annual investment of US$ 55,000, (45,300 Euro) the 1047 FTE total staff assigned to state regulatory programs focused on forestry practices requires an annual investment of about US$57.6 million (47.8 million Euro) nationally. Of this total, about 73% is accounted for by the regulatory programs of state agencies in 15 states (Ellefson et al., 2004).

6. Performance of regulatory programs

6.1. Standards for judging performance

Regulatory programs generally are judged to be worthwhile in the context of a wide variety of standards, including standards that promote program effectiveness, efficiency and good governance. Although agreement on the specificity of individual standards is often subject for intense debate, program standards that promote results, encourage participation, and seek rich sources of information would probably be agreed to by most.

Standards for judging the merits of forest practice regulatory programs have been suggested by many (Mazmanian and Sabatier, 1981; Cheng and Ellefson, 1993; Lubbers, 1994; Ellefson et al., 1995; Ellefson, 2000; Organization for Economic Co-operation and Development, 1997, 1999; Davies and Mazurek, 1998; Rose and Coate, 2000; Society of American Foresters, 2002; Hoerger, 1993). Summarized from a forestry perspective, effective forest practices regulatory programs should exhibit the following:

- *Net benefits occur and are measurable.* Changes in pollutants and forest health conditions exist and are measurable; pollutant redaction or forest health improvements are meaningful; landowners' and harvesters' sensitivity to potential impacts of forest practices is enhanced; and certainty for investors is greater.
- *Compliance with rules is possible.* Forest practice rules are technically and economically feasible to apply; flexible to meet varying forest resource and

administrative conditions exists; and the authority and resources to enforce the rules are available.

- *Program is cost-effective.* Private-sector costs of compliance are considered and dealt with; agency costs to develop, promulgate, and implement forest practice rules are low; and agencies with similar regulatory or resource management responsibilities coordinate their efforts.
- *Rule development is open and constructive.* Processes are clear, predictable, and timely and decision has an endpoint; goals and the forest practice technologies to achieve them are discussed early in the process; specialized approaches (regulatory rule negotiation) for minimizing potential litigation are appropriately used; risks, costs, and administrative procedures can be analyzed; and values such as privacy, due process and private property are accommodated.
- *Information is abundant.* Effectiveness and compliance monitoring systems exist and provide useful information, and research capacity to address critical information voids is available.
- *Statutory intent is constructively promoted.* Healthy balance exists between statutory specification of forest practices and discretionary authority; statutory deadlines for accomplishing legislative intent are reasonable; and legislative overview of regulatory program progress is constructive.

6.2. Measuring performance

Approaches to evaluating performance of regulatory programs in general are many and are varied in their ability to provide useful insights. They include controlled experiments, retrospective studies, constituency surveys, administrative judgments, and comparisons with specified indicators of success (Harris and Scheberle, 1998; Worthen et al., 1997). Since each approach has its strengths and limitations, the selection of an approach for evaluation of performance necessitates careful consideration of situational circumstances, including the resources available for analysis (for example, time, finances, professional talent), ability to identify and measure outcomes, access to cost and benefit information (for example, proprietary restrictions on data), ability to control application of analytical procedures (for example, analysis of large amounts of information), and the extent to which baselines can be determined as required for with-and-without analyses. These circumstances are often aggravated by incomplete and uncertain information, political disagreements over the need for a particular regulation, and the subjective assumptions that are often embodied in analytical tools (thereby exposing them to bias and manipulation) (Behan, 2003; Knaap and Kim, 1998; May, 1993; Morganstern, 1997, 1999, National Academy of Public Administration, 1994; Reams, 1995; U.S. General Accounting Office, 1999).

Focusing on evaluation of forest practice regulatory programs, past evaluations of their performance have been oriented around certain themes or broad topical areas, namely, analyses that (Table 7)

- compare the efficiency and effectiveness of state regulatory programs with programs that are non-regulatory in nature (for example, compare regulatory programs to tax and fiscal programs, or to voluntary educational programs, or to forest certification programs, or to states not making use of regulation).
- assess regulatory program ability to heighten the rate at which proper forestry practices are applied (or bad practices discouraged) (for example, application of acceptable forestry practices in regulated versus non-regulated conditions).
- evaluate the physical, economic and political consequences of regulatory programs (for example, regulatory impacts on employment, timber harvest volumes, reforestation activities, future forest investments, sale of forest property, public and private costs of compliance).
- appraise the governance and organization of regulatory programs (for example, legal authority and constitutional limitations, agency responsibilities and coordination, monitoring and enforcement systems).

6.3. Regulatory versus non-regulatory programs

As part of this 2003 assessment, administrators of state forestry programs were asked to judge how well different types of programs promoted the correct application of each of the seven major categories of forestry practices previously described. Five types of

programs were considered, namely, extension education, technical assistance, tax incentive, financial incentive, and regulatory programs. Recognizing that these programs are seldom used separately (most often used in some combination), program administrators were asked to judge each program on a scale of one to five (where "one" was least effective and "five" most effective).

Responding from all 50 states, program administrators judged extension education and technical assistance programs to be most effective in obtaining correct application of forestry practices generally, while tax incentive programs were rated least effective (Table 8). Technical assistance programs were rated most effective for accomplishing six of the seven forest practice categories considered. Only for purposes of forest protection was the effectiveness of technical assistance programs exceeded by another type of program (extension education programs). Regulatory programs ranked fourth (out of five) in effectiveness for all major categories of forestry practices. When used, regulatory programs were considered to be most effective for directing the application of chemicals (ranked third for such purposes) and least effective when focused on cultural practices. Ranked from most to least effective, the forestry practices considered most likely to benefit from a regulatory approach were chemical application practices, road and trail practices, administrative practices (tied in rank with road and trail practices), timber harvesting practices, forest protection practices, reforestation practices, and cultural practices.

7. Summary and observations

Government programs regulating forestry practices applied to private forests are one of many different types of policy instruments that can be used for such purposes. A 2003 assessment of state administered regulatory programs in the United States determined that various types of forest practices are subject to regulation (all practices are regulated to some degree by 64% of state governments), many government agencies are engaged in the regulation of forest practices (average of six agencies per state, 54% of which are extensively or moderately involved), coordination among agencies with regulatory responsibilities is modest (42% regularly coordinate, the remainder seldom or never coordinate), sizable staffs are devoted to the implementation of regulatory programs (nearly 1050 FTE staff, representing an annual state government investment of US$57.6 million [47.8 million Euro]), regulatory program effectiveness is judged to be modest when compared to non-regulatory programs (ranked fourth out of five regulatory and non-regulatory programs), standards for judging regulatory program performance are numerous (for example, existence of measurable net benefits, cost-effective operation of program, regulated public can comply with rules, statutory intent is advanced, information depicting program is abundant and available), and past evaluations of regulatory programs have taken many forms (comparison of regulatory and non-regulatory programs, analysis of marginal gain in acceptable application of practices,

Table 8
Effectiveness of major state government programs in promoting correct application of forestry practices on private forests in the United States, by major forestry practice category, 2003

Major category of forestry practices	Effectiveness of program in promoting correct application of each major category of forestry practices (5=most effective... to... 1=least effective)				
	Extension education programs	Technical assistance programs	Tax incentive programs	Financial incentive programs	Regulatory programs
Road and trail practices	3.76	3.80	1.67	2.82	2.96
Timber harvesting practices	3.90	3.98	1.83	2.52	2.80
Reforestation practices	3.30	3.84	2.46	3.36	2.04
Cultural practices	3.60	4.16	2.17	3.34	1.74
Chemical application practices	3.76	3.84	1.74	2.49	3.18
Forest protection practices	3.92	3.88	1.77	2.74	2.60
Administrative practices	3.72	3.92	1.96	2.38	2.96
All major categories	3.71	3.91	1.83	2.81	2.60

5=most effective, 4=somewhat effective, 3=average effectiveness, 2=marginally effective, 1=least effective.

evaluation of physical and economic consequences of regulation, appraisal of regulatory program governance structures).

8. Emerging research needs

Managers of regulatory programs were asked to identify information that would enable them to improve the performance of the regulatory programs for which they are responsible. Suggested as avenues for future research, the following major categories were identified.

Assessment of sectors requiring regulatory attention. The ownership of forests is diverse as is the variety of benefits that forests are capable of providing. Within this diverse setting are their certain landowner categories and kinds of forest benefits that require regulatory attention? Do certain categories of private landowners require a regulatory approach in order to ensure the sustainability of the forests for which they are responsible? Similarly, are there certain types of benefits provided by forests that are of such high value that the impact of certain forestry practices challenges their very existence and, consequently, need to be protected by government regulation?

Development of creative and imaginative alternatives. Regulatory programs are one among a broad array of programs that can be used to secure the public interest in private forests. Are there program alternatives (including regulatory programs of which there are many styles) that might also be able to address problem externalities that result from the application of certain forestry practices? Are there programmatic approaches used by other sectors (for example, agriculture, mining, transportation, law enforcement) that should be considered for possible application in the forest resource sector (for example, product or practice certification, permits and licenses, environmental covenants, voluntary self-regulation, environmental reporting, tradable resource rights, liability instruments, performance bonds, ownership trusts, long-term leases)?

Evaluation of regulatory program performance. Regulatory programs (and alternatives to them) deserve continuing and comprehensive analysis of their performance. What are the relative costs and benefits attributable to regulatory programs, and by what standards should these costs and benefits be judged? How might the accuracy of benefits and costs attributable to regulatory programs be improved? What can be said of the efficiencies that might result from synergies occurring when regulatory and non-regulatory programs are merged in various combinations? What about regulatory program performance when with-and-without analyses are applied? What are the broader sector-wide and economic structural implications of regulatory programs?

Assessment of the distributional consequences of regulatory programs. Regulatory programs seek to internalize the adverse consequences of applying forestry practices. By so doing, the presumption is that such costs can be transferred to broader markets where all benefits and costs of a forestry operation might be more appropriately allocated. Such may not be the case. What are the distributional consequences of regulatory programs, and how do they compare with alternative programs attempting to achieve the same public interest in private forests? Are some forest sectors more likely to bear greater regulatory costs, while some beneficiaries reap rewards for which they have not been charged? How might regulation-inspired inequitable conditions be remedied, by markets or by government actions (for example, taxation, fiscal incentives)?

Design of regulatory institutional structures. Regulatory programs can be established, organized, and administered in various ways by different levels of government and by different agencies within a government. How should regulatory responsibility for forestry practices applied on private forests be allocated between levels of government and within a given level of government? Within any single level of government, are competing regulatory responsibilities a problem, and, if so, how might they be addressed? Is there a role for the private sector in implementing certain parts of a regulatory program (for example, compliance monitoring, on-site inspections)? Are rule-development procedures effective and, if not, are there better ways of engaging the regulated public in rule making processes. What conditions merit statutory prescription of forest practice standards and what conditions imply the placement of standards in administrative rules? Performance-based standards (for example, specified

level of water quality) provide for creativity by the regulated public, while prescriptive forest practices (for example, culverts installed every 100 m) limit such creativity. What is the proper blend of standards versus prescriptive practices, and under what circumstances should emphasis be given one or the other? What approaches might be used to ensure that science-based forest practices standards and well-designed administrative processes are continually being incorporated into regulatory initiatives?

Development of information and information management systems. Efficiently operating regulatory programs depend on access to sizable quantities of information that must be current and available in user-friendly forms. What type of systems might better be able to process information required from the regulated public (for example, notifications, permit requests)? Are there information system designs that can more effectively digest and report current conditions and trends in regulatory programs generally (for example, responsible agencies, types of programs, investment levels, effectiveness and efficiency), and from a performance perspective, are there information systems that can better promote consistency in the gathering of information about regulatory programs and consistency in the manner in which regulatory impact analyses are conducted?

Acknowledgments

This assessment was funded by the MN Agricultural Experiment Station and by the Southern Research Station, Forest Service, U.S. Department of Agriculture.

References

Behan, R.D., 2003. Why measure performance: different purposes require different measures. Public Administration Review 63 (5), 586–606.

Cheng, A.S., Ellefson, P.V., 1993. State Forest Practice Laws and Regulations: A Review of Constitutional and Legal Environments. Staff Paper Series No. 88. Department of Forest Resources. University of Minnesota, St. Paul, MN.

Cleaves, D., Bennett, M., 1995. Timber harvesting by nonindustrial private forest owners in western Oregon. Western Journal of Applied Forestry 10 (2), 66–71.

Davies, J.C., Mazurek, V., 1998. Pollution Control in the United States: Evaluating the System. Resources for the Future, Washington, DC.

Ellefson, P.V., 2000. Has Gifford Pinchot's regulatory vision been realized? Journal of Forestry 98 (5), 15–22.

Ellefson, P., Miles, V., 1985. Protecting water quality in the midwest: impact on harvesting costs. Northern Journal of Applied Forestry 2 (2), 57–61.

Ellefson, P.V., Cheng, A.S., Moulton, R.J., 1995. Regulation of Private Forestry Practices by State Governments. Station Bulletin 605-1995. Minnesota Agricultural Experiment Station. St. Paul, MN: University of Minnesota.

Ellefson, P.V., Moulton, R.J., Kilgore, M.A., 2003. Public agencies and bureaus responsible for forest management and protection: an assessment of the fragmented institutional landscape of state governments in the U.S. Journal of Forest Policy and Economics 5, 207–223.

Ellefson, P.V., Kilgore, M.A., Hibbard, C.M., Granskog, J.E., 2004. Regulation of Forestry Practices on Private Land in the United States: Assessment of State Agency Responsibilities and Program Effectiveness. Staff Paper Series No. 176. Department of Forest Resources, University of Minnesota, St. Paul, MN.

Ellefson, P.V., Hibbard, C.M., Kilgore, M.A., Granskog, J.E., 2005. Legal, Institutional, and Economic Indicators of Forest Conservation and Sustainable Management: Review of Information Available for the United States. General Technical Report SRS-82. Asheville, NC: Southern Station, Forest Service, U. S. Department of Agriculture.

Green, P.F., 1982. Government regulation in the forests: impacts of the 1973 California Forest Practices Act. Environmental Quality Series No. 36. Institute of Governmental Affairs and Institute of Ecology. University of California, Davis, CA.

Greene, J.L., Siegel, W.C., 1994. The Status and Impact of State and Local Regulation on Private Timber Supply. General Technical Report RM-255. Rocky Mountain Forest and Range Experiment Station. Forest Service. Fort Collins, CO: U. S. Department of Agriculture.

Harris, H.J., Scheberle, D., 1998. Ode to the Miners' Canary: the search for environmental indicators. In: Knaap, G.J., Kim, T.J. (Eds.), Environmental Program Evaluation: A Primer. University of Illinois Press, Chicago, IL.

Henly, R.K., 1992. Cost of Small Landowner Timber Harvesting Plans. Strategic and Resources Planning Staff. CA Department of Forestry and Fire Protection, Sacramento, CA.

Henly, R.K., Ellefson, P.V., 1986. State Forest Practice Regulation in the United States: Administration, Costs and Accomplishments. Bulletin AD-3011. Agricultural Experiment Station. University of Minnesota, St. Paul, MN.

Hoerger, F.D., 1993. Desirable Attributes of Environmental Regulations. Discussion Paper CRM 93-01. Center for Risk Management. Resources for the Future, Washington, DC.

Johnson, R.L., Alig, R.J., More, E., Moulton, R.J., 1997. NIPF landowners' view of regulation. Journal of Forestry 95 (1), 23–28.

Kelson, A.R., Lilieholm, R.J., Lyon, K.S., 1994. Impact of Pacific northwest environmental regulation on international timber supply. Western Journal of Applied Forestry 9 (3), 77–80.

Kilgore, M.A., Blinn, C.R., 2004. Policy tools to encourage the application of sustainable timber harvesting practices in the United States and Canada. Journal of Forest Economics and Policy 6 (2), 111–127.

Knaap, G.J., Kim, T.J., 1998. Environmental program evaluation: framing the subject, identifying issues. In: Knaap, G.J., Kim, T.J. (Eds.), Environmental Program Evaluation: A Primer. University of Illinois Press, Chicago, IL.

Lickwar, P., Hickman, C., Cubbage, F., 1992. Costs of protecting water quality during harvest on private forestlands in the southeast. Southern Journal of Applied Forestry 16, 13–20.

Lubbers, J.S., 1994. Better regulations: the National Performance Review's regulatory reform recommendations. Duke Law Journal 43 (6), 1165–1179.

May, P.J., 1993. Mandate design and implementation: enhancing implementation efforts and shaping regulatory styles. Journal of Policy Analysis and Management 12 (4), 634–663.

Mazmanian, D.A., Sabatier, P., 1981. Effective Policy Implementation. Lexington Publisher, Lexington, MA.

McKillop, W., 1993. Economics of Forest Practice Regulation in California. Policy and Forestry: Design, Evaluation, and Spillovers. Proceedings of the 1993 Southern Forest Economics Workshop. Southern Research Station. Forest Service. U.S. Department of Agriculture, Asheville, NC.

Morganstern, R.D., 1997. The legal and institutional setting for economic analysis at EPA. Economic Analyses at EPA: Assessing Regulatory Impact by R.D. Morganstern. Resources for the Future, Washington, DC.

Morgenstern, R.D., 1999. An historical perspective on regulatory decision making: the role of economic analysis. In: Sexton, K., Marcus, A.A. (Eds.), Better Environmental Decisions: Strategies for Governments, Businesses, and Communities and others. Island Press, Washington, DC.

National Academy of Public Administration, 1994. Toward Useful Performance Measurement: Lessons Learned from Initial Piolet Performance Plans Prepared under the Government Performance and Results Act. National Academy of Public Administration, Washington, DC.

National Archives and Records Administration, 1993. Regulatory Planning and Review. Executive Order 12866. Codification of Proclamations and Presidential Executive Orders. National Archives and Records Administration, Washington, DC.

Organization for Economic Co-operation and Development (OECD), 1997. OECD Report on Regulatory Reform: Synthesis. OECD Reviews of Regulatory Reform. Organization for Economic Co-operation and Development, Paris, France.

Organization for Economic Co-operation and Development (OECD), 1999. Government Capacity to Assure High Quality Regulation in the United States. OECD Reviews of Regulatory Reform. Organization for Economic Co-operation and Development, Paris, France.

Perez-Garcia, J., 2001. Cost Benefit Analysis for New Proposed Forest Practice Rules Implementing the Washington Forests and Fish Report. Division of Forest Practices. Department of Natural Resources, Olympia, WA.

Reams, M.A., 1995. Incentive-based versus command-and-control approaches to improving environmental quality. Spectrum 68, 6–18 (Fall).

Rose, R., Coate, J., 2000. Reforestation rules in Oregon: lessons learned from strict enforcement. Journal of Forestry 98 (5), 24–28.

Society of American Foresters, 2002. Public Regulation of Private Forest Practices: A Position Statement. Society of American Foresters, Bethesda, MD.

Stier, J.C., Martin, A.J., 1997. Economic impacts of timber harvest regulations in the Lower Wisconsin State Riverway. Northern Journal of Applied Forestry 14 (3), 126–134.

U.S. General Accounting Office, 1999. Environmental Protection: Assessing the Impacts of EPA's Regulations Through Retrospective Studies. GAS/RCED-99-250. U.S. Congress. United States General Accounting Office, Washington, DC.

U.S. General Accounting Office, 2002. Regulatory Programs: Balancing Federal and State Responsibilities for Standard Setting and Implementation. GAO-02-495. U.S. Congress. United States General Accounting Office, Washington, DC.

Vaux, H.J., 1983. State interventions on private forests in California. In: Sedjo, R.A. (Ed.), Government Interventions, Social Needs, and Management of U.S. Forests. Resources for the Future, Washington, DC, pp. 124–168.

Weyerhaeuser. 1992. Macro Impacts of Proposed Forest Practice Rules in Washington. Unpublished Research Paper Reference Number sl/d0511/cl-1. Federal Triangle, WA: Weyerhaeuser.

Woodman, J.N., Cubbage, F.W., 1994. Potential costs of mandatory best management practices in Georgia. Proceedings of 24th Southern Annual Forest Economics Workshop School of Forest Resources. University of Georgia, Athens, GA, pp. 309–322.

Worthen, B.R, Sanders, J.R., Fitzpatrick, J.L., 1997. Program Evaluation: Alternative Approaches and Practical Guidelines. Longman Publishers, New York, NY.

Zobrist, K., Lippke, B.R., 2003. Case studies examining the economic impacts of new forest practices regulations on NIPF landowners. In: Teeter, L., Cashore, B., Zhang, D. (Eds.), Forest Policy for Private Forestry: Global and Regional Challenges. CABI Publishing, New York, NY, pp. 203–210.